LIMITED ENVIRONMENTAL SITE INVESTIGATION

OF

DEXTER WATER MANAGEMENT SYSTEMS

FOR

DEXTER
7145 PINE STREET
CHAGRIN FALLS, OHIO 44022

MALCOLM
PIRNIE

1.0 INTRODUCTION

The Mogul Corporation, dba Dexter Water Management Systems Division (DWMS) of Chagrin Falls, Ohio, retained Malcolm Pirnie, Inc (Malcolm Pirnie) to review background information regarding their facility. The information provided by DWMS included a Preliminary Assessment (PA) prepared by the Ohio EPA (OEPA) and a Site Inspection (SI) report prepared by the US EPA FIT Team. The reports indicated that the facility may be a potential source of soil and ground water contamination. The US EPA ID number for the site is OHD004180675. DWMS produces compounds used for treatment of both industrial process water and potable water supplies. A list of the background files and reports which were provided by DWMS is presented on Table 1.

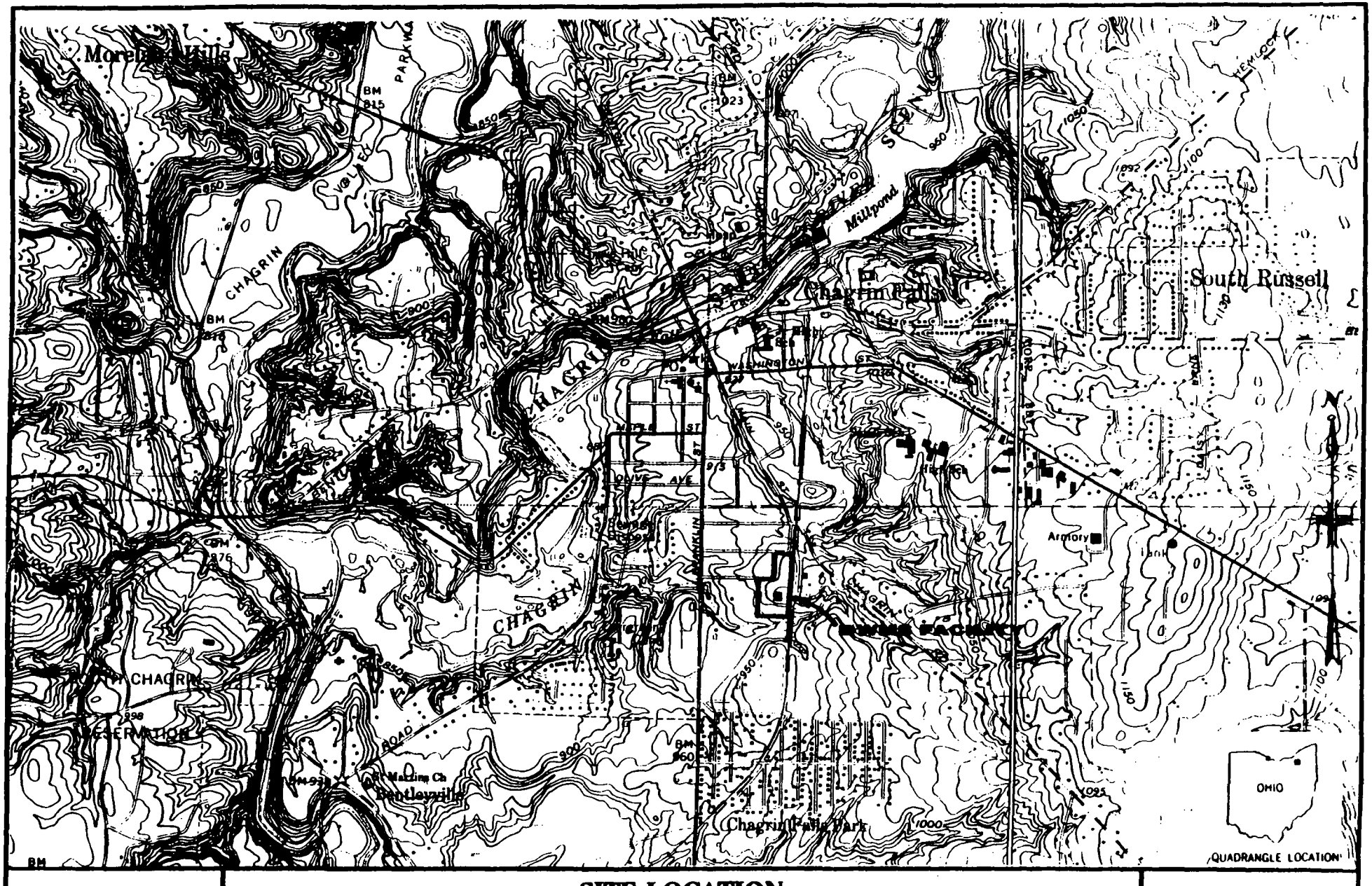
After Malcolm Pirnie reviewed background information regarding the site, DWMS requested an investigation of the source of ground water contamination. The organic contaminants were detected in samples collected from the potable ground water wells located at the DWMS facility and in several adjacent residential wells. The following report presents the results of the field investigation.

1.1 Site Description and Location

DWMS, shown on Figure 1, is located at 7145 Pine Street, in Bainbridge Township, Geauga County near the southeast corner of Chagrin Falls, Ohio. The facility consists of five buildings shown on Figure. They are used for administration, sales, manufacturing, and research. There are two residential buildings located on Mogul Street which are also owned by DWMS. According to the SI report, the facility occupies "approximately 14.5 acres situated in a mixed residential/commercial area." Most of the surrounding area is residential with the exception of warehouses located to the east and a small tavern to the north of the DWMS property.

1.2 Site History - Overview

Manufacturing activities at the facility location began in the mid to late 1800's. The first recorded deed for the property is dated November 6, 1893 when the property was sold to the Chagrin Manufacturing Company. The property was occupied from that time until the mid-1930's by manufacturers involved in iron and steel casting and fabricating operations. On March 25, 1936 the property was purchased by Eff Laboratories. The available records did not indicate the type of business conducted by this owner. On March



MALCOLM PIRNIE

SITE LOCATION

DEXTER WATER MANAGEMENT SYSTEMS DIVISION

USGS 7-1/2 MINUTE SOUTH RUSSEL OHIO AND CHAGRIN FALLS, OHIO QUADRANGLES

FIGURE 1

FILE/pcj
1178-08-1

TABLE 1

DWMS
DOCUMENT LIST

DATE	REF. NO.[1]	ITEM
5/12/67	6.	Memo from Herb Davidson (General Biochemicals) to Staff
9/6/71	6.	Pollution Investigation by a game protector Observed pollutant in an unnamed tributary of the Aurora Branch of the Chagrin River
3/2/72	6.	Memo from A.P. Kretz to H.M. Davidson
7/3/74	6.	Discharge Monitoring Report for NPDES for 1/1 - 3/31, 1974
7/22/74	6.	Memo from Ronald L. Ostop (Asst. Chief - Div. of Surveillance NEDO) to William J. Flaherty (Legislative Liaison, Office of Police Development)
8/7/80	1.	Notification of Hazardous Waste Activities
5/5/81	1.	Interviews with Ray Long, Herb Davidson, George (?), Larry Gaylar
5/8/81	1.	Interviews with Jack Rown, Pete Riviera, Frank Simon
5/20/81	1.	Memo from D.L. Wilbur (Mogul) to R.L. Greco (GIBCO) Re: Superfund Notification of GBI disposal practices
5/20/81	1.	EPA Form Notification of Disposal Practices
No Date	1.	Photo Copy of 6/7/66 Newspaper article of a fire
No Date	1.	Photocopies of stock and advertisements, patent applications
No Date	1.	Photocopies of newspaper articles
No Date	1.	Notes from "A Short History of Technology"
No Date	1.	Pollution Legal Liability Application for Waste Generator Appendix A - Raw Materials
5/21/81	1.	Interview with Mr. Denson (Chagrin Falls Water Dept.)

TABLE 1 (Continued)

DWMS
DOCUMENT LIST

DATE	REF. NO.[1]	ITEM
5/22/81	1.	Letter from D.L. Wilbur (Mogul) to Richard J. Denny
Not Dated (Approx. 5/26/81)	1.	Interview with Mrs. Donald Stern
5/26/81	1.	Interview with D.R. Wilson (?)
5/26/81	1.	Interview with Dick Denney
5/26/81	1.	Interviews with Mr. Denson (Water Dept.) and Frank Stanek
5/27/81	1.	Interview with Mrs. Wince
5/27/81	1.	Interview with Duane Smith
5/28/81	1.	Interviews with G.K. Smoleny and Ray Long
6/2/81	1.	Interview with Elizabeth Rodgers
6/8/81	1.	Title History 1. Title History from 11/6/1893 2. Deeds Index 3. Tax records 1895-1928 4. Bainbridge Center Business Center Maps
6/8/81	1.	Letter from D.L. Wilbur (Mogul) to USEPA Region 5
6/8/81	1.	EPA Form Notification of Hazardous Waste Site
6/8/81	1.	Title History - Narrative
6/8/81	1.	Title History Narrative of Plant 1 Building
6/18/81	1.	Memo from R.F. Weidner (Mogul) to File Re: Final Conclusions of CN Sampling of Well No. 3
7/15/81	1.	Memo from R.F. Weidner (Mogul) to File Re: Initial results of CN Sampling of Well No. 3
7/31/(81?)	1.	Respondent Contact Record
11/22/83	1.	Telephone Call Report from Ken Kruger (E & E) to D.L. Wilbur
No Date	1.	Letter of Introduction from Valdas Adamkus (Region 5 EPA) to Mogul Corp for Ken Kruger (E & E).

TABLE 1 (Continued)

DWMS
DOCUMENT LIST

DATE	REF. NO.[1]	ITEM
11/29/83	1.	Telephone Call Report from D.L. Wilbur to Ken Kruger (E & E)
11/29/83	1.	Telephone Call Report from Tom Burn to D.L. Wilbur
11/30/83	1.	Memo from D.L. Wilbur to R.G. Tonkyn Re: E & E Site Visit
7/10/84	1.	USEPA Form - Potential Hazardous Waste Site - Preliminary Assessment
7/13/84	1.	File Note Potential Hazardous Waste Site - Preliminary Assessment Narrative
5/7/85	1.	Letter from Steven White (Ohio EPA) to Mogul Corp.
5/13/85		Letter from D.L. Wilbur to Steven White (Ohio EPA)
Not Dated (Approx. 5/13/85)	1.	Letter from Gary Gifford (Ohio EPA) to D.L. Wilbur
5/12/89	1.	Letter from Thomas Geishecker (Region 5 EPA) to Mr. Besel (Ohio EPA)
8/9/89	1.	Fax from Jon Nagle to Jim Mayerhofer Re: E & E Sampling in 1989
8/11/89	1.	Letter from Jeryl Kolb (E & E) to Dennis Bores
Rec. 8/14/89	1.	Letter of Introduction from Valdas Adamkus (Region 5 EPA) to Mogul Corporation for Jerry Kolb (E & E)
No Date	1.	Secrecy Agreement from Jeryl Kolb (E & E)
No Date	1.	USEPA Form - Potential Hazardous Waste Site - Site Inspection Report
11/14/89	3.	Memo/Analytical Results from J. Kolb (RWI) to William Messenger (USEPA) Transmittal of drinking water analyses performed during the E & E site visit.
11/27/89	1.	Letter from D.L. Wilbur to Lily Aaron (Ohio EPA)

TABLE 1 (Continued)

DWMS
DOCUMENT LIST

DATE	REF. NO. [1]	ITEM
1/2/90	3.	Letter from Deborah Gray (Department of Health) to Mogul Corp. Transmittal of drinking water analyses performed during the E & E site visit.
4/6/90	2.	Report - Ecology & Environment, Inc. Screening Site Inspection Report for Mogul Corp., Chagrin Falls, Ohio. (USEPA ID:OHD004180675). Report of the Site Inspection performed by Ecology & Environment, Inc. on August 22, 1989. During the site visit, eight soil/sediment samples were collected and 5 residential wells were sampled. The SI collected data specifically for use in the HRS. The appendices contain a 4 mile radius site map, USEPA Form 2070-13 (The Potential Hazardous Waste Site-Site Inspection Report, Field Investigation Team (FIT) site photographs, the USEPA Target Compound List (TCL) and Target Analyte List (TAL) quantitation/detection limits, and well logs of the area of the site.
7/3/90	2.	Letter from William Messenger (USEPA) to Dennis Bores (Mogul Corp.) Transmittal of completed SI (Site Inspection) report to Mogul Corp.
9/24/90	5.	Memo from Jon Nagle (Dexter) to Dennis Bores (Dexter) Discussion of meeting on sampling initiated by R. Thomas Burns. The samples were collected at 7205 and 7207 Chagrin Road.
No Date	1.	Sample Results of Burns property (1 and 2)
10/2/90	4.	Analytical Report from Joe Cluts (Dexter) to Jim Story (Dexter) Results of metal analyses for samples collected 9/20/90 from sites 4, 5, 6, and 7.

TABLE 1 (Continued)

DWMS
DOCUMENT LIST

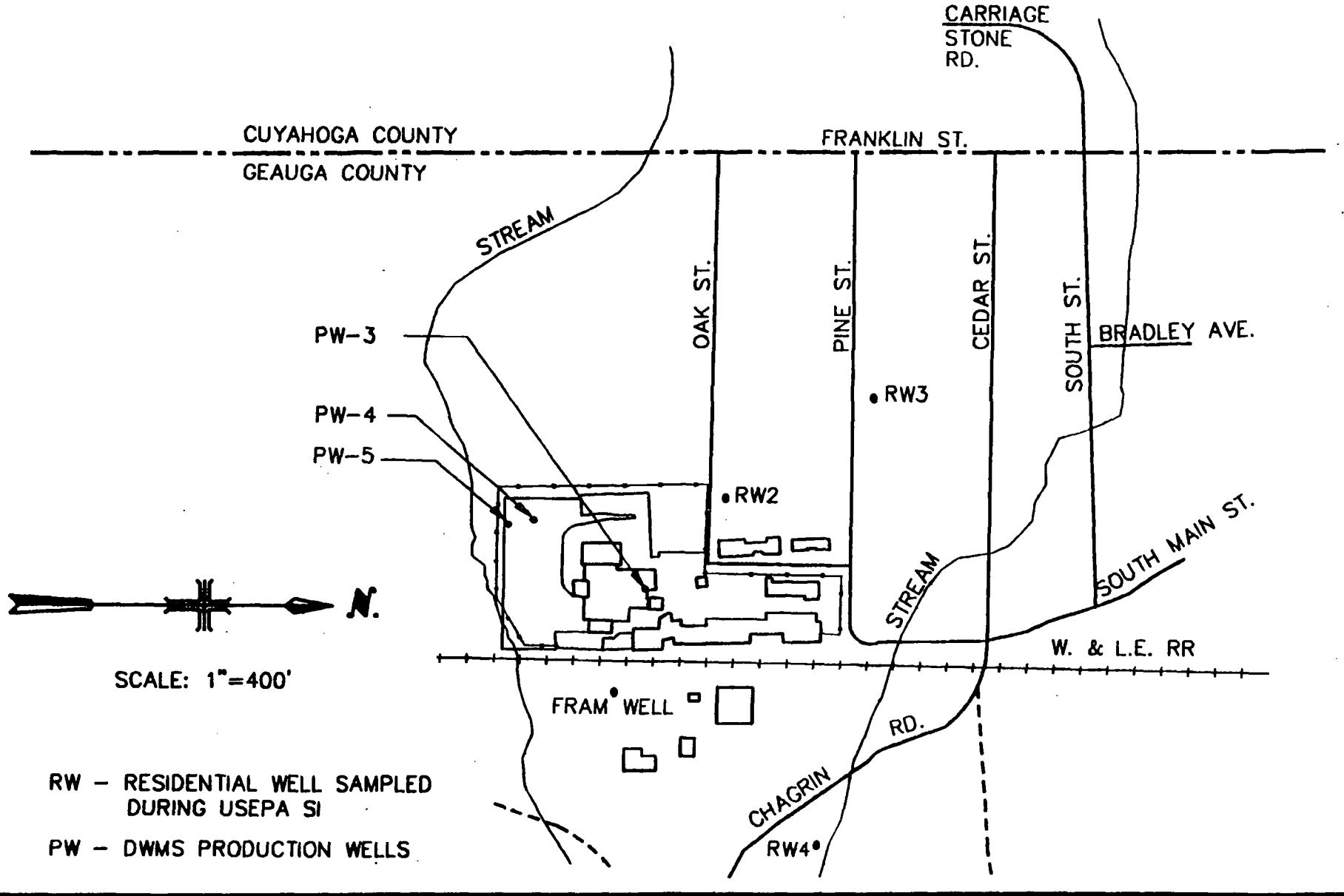
DATE	REF. NO. [1]	ITEM
No Date	4.	Analytical Report from BHM Analytical Laboratories, Inc. to Jim Story (Dexter) Results of Organic TCLP analyses for 4 sites (received by the lab on 10/10/90) listed as 2, 4, 5, 7. The sample locations correspond to the E & E sample location collected during the SI. The analyses performed were: Sample 2, PCB/Pesticide; Sample 4, TCLP Volatile; Sample 5 and 7, TCLP Semi-Volatile.
10/30/90	5.	Letter from Dennis Bores (Dexter) to Ronald Janke (Jones, Day, Reavis & Pogue) Transmittal of metals data from sampling initiated by R. Thomas Burns.
11/5/90	5.	Letter from Dennis Bores (Dexter) to R. Thomas Burns (RTB Group) Transmittal of metals data from sampling performed on 8/22/89 and initiated by R. Thomas Burns. The letter includes a description of the sampling locations, and the results of the sample analyses for total metals, Toxicity Characteristic Leachate Procedure (TCLP) calculated from total digested results, and a TCLP analyses.
11/5/90	4.	Note from Jim (Story?) to Jon (Nagle?) Description of sample sites and analytical procedure
11/8/90	4.	Letter from Dennis Bores (Dexter) to Ronald Janke (Jones, Day, Reavis & Pogue) Transmittal of organics data from CERCLA Background Information

TABLE 1 (Continued)

DWMS
DOCUMENT LIST

DATE	REF. NO.[1]	ITEM
11/26/90	3.	Letter from Dennis Bores (Dexter) to Ronald Janke (Jones, Day, Reavis & Pogue) Transmittal of letter and report received from the Ohio Department of Health.
12/6/90	6.	Letter from Dennis Bores (Dexter) to Ronald Janke (Jones, Day, Reavis & Pogue) Transmittal of information regarding well-water, discharge permit, and an alleged discharge complaint
No Date	2.	Bound Report - USEPA 40 CFR30 Hazardous Ranking System (HRS) - Final Rule

[1]Item reference number listed in 12/3/90 letter to D.G. Sherman (Malcolm Pirnie) from Dennis Bores (Dexter) dated 12/3/90. Items listed with Number 6 were transmitted to Malcolm Pirnie on 12/6/90.



MALCOLM PIRNIE

SITE PLAN
DEXTER WATER MANAGEMENT SYSTEMS DIVISION

FIGURE 2

DEXTER/PEJ
1178-08-1

1, 1939 the property was sold to General Biochemical, Inc (GBI), a subsidiary of the Mogul Corporation.

1.3 Previous Investigations

According to the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) the DWMS facility was first entered into the US EPA system on September 1, 1980. Superfund Section 103 (c) Notification Forms were filed by DWMS on June 8, 1981. The PA, conducted by the OEPA, was completed on July 13, 1984 and submitted to Dexter in a letter from OEPA dated May 7, 1985. The PA concluded that although organic and inorganic wastes had been generated on-site, the quantities were small and there was no evidence to suggest that improper disposal practices had been used to handle the wastes. The report also noted that wastes had been hauled off site since 1968. The OEPA recommended that the facility be assigned a low priority for further investigation of the site.

On April 6, 1990 the US EPA FIT Team completed the SI report. Analytical results presented in the SI indicated that several organic compounds were present in ground water samples collected from residential wells in the area. Based on our review, there were no data presented in the SI which linked DWMS operations to the types of compounds detected.

2.0 FIELD INVESTIGATION

2.1 Soil Gas Survey

A soil gas study was conducted to determine whether volatile organic vapors are present in the shallow soils at the perimeter of the facility. The data were collected to identify on site areas and areas adjacent to DWMS which could be potential sources of contaminants. Although this type of survey could not be conclusive, it was used as a screening to tool to identify areas of interest which could be investigated in more detail as part of future facility investigations.

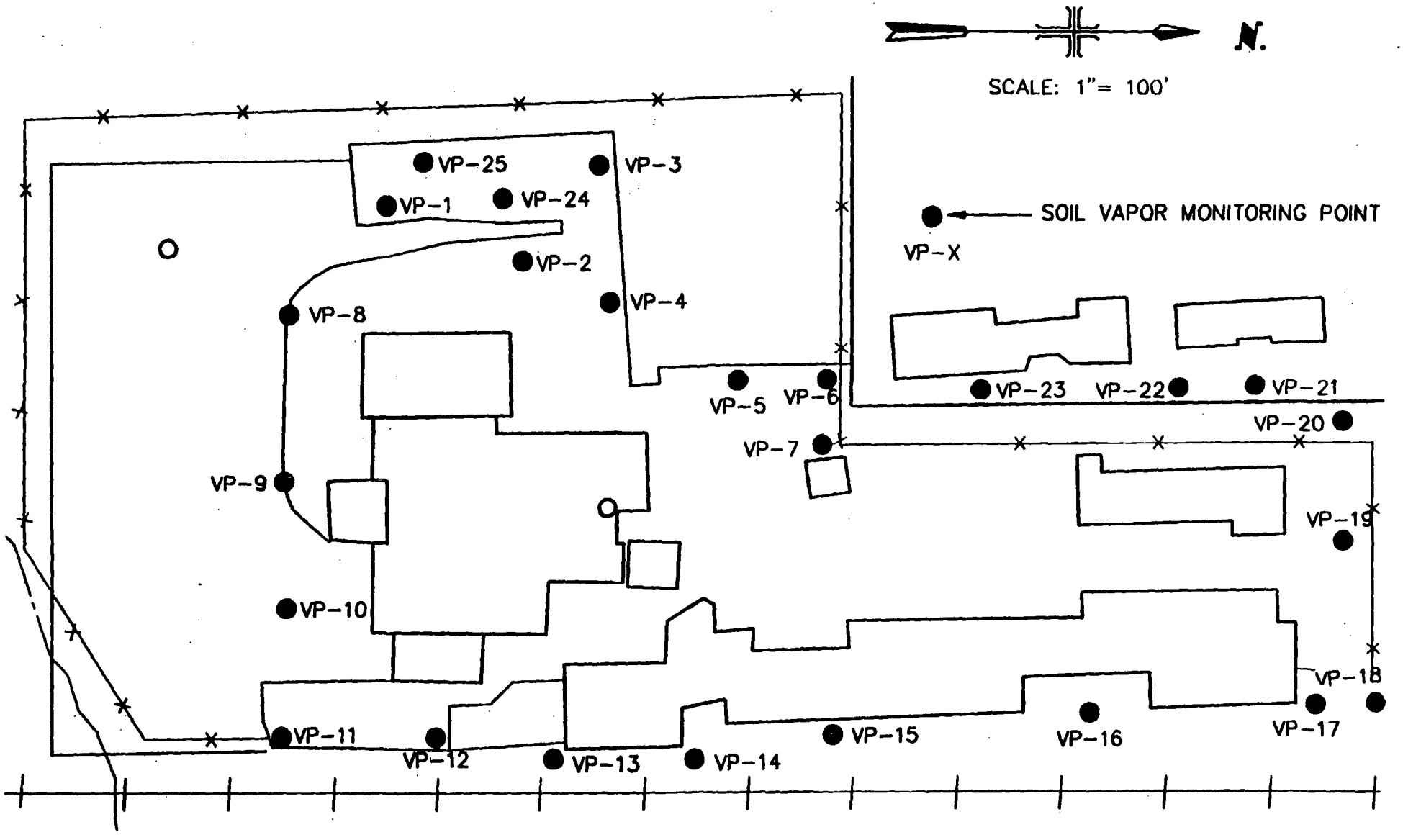
The soil vapor survey consisted of sampling the soil gas at locations which were spaced approximately every 100-feet around the perimeter of the site. Soil vapor samples were collected at a depth of approximately three feet below the ground surface at each sampling location. Sampling locations and a summary of the results are presented on Figure 3 and Table 2, respectively.

Because of the presence of the saturated areas and the relatively impermeable clays, some of the sampling locations were off-set to areas of higher elevation or more permeable soil. Several of the sampling locations were completely eliminated due to site conditions.

In some areas, mostly on the east side of the facility, soils were saturated which precluded collection of soil gas samples. Several other sampling locations on the southwest corner of the facility were underlain by moist to wet clay. Gas samples could not be collected at these locations. An unnumbered sampling location (between VP-15 and VP-16) on the east side of the site was located approximately 20 feet from an area of standing water. An attempt to sample soil gas at this location was also unsuccessful.

Calibration of the Photovac 10S50 gas chromatograph was accomplished by injecting 20 μl of a standard consisting of 10 ppm benzene in air. The sample injection volume of 200 μl effectively concentrated the samples by a factor of ten. This allowed detection of compounds which may have been present at concentrations below normal instrument detection limits. Detection limits at the time of the sampling effort were calculated to be 0.053 ppm and 0.037 ppm benzene equivalents for April 3, 1991 and April 4, 1991, respectively.

Many of the soil gas samples indicated the presence of volatile organic compounds at the perimeter of the facility. To account for varying conditions in the field, the response factor for benzene was calculated for each day of sampling to provide accurate data.



MALCOLM PIRNIE

SOIL VAPOR SAMPLING LOCATIONS
DEXTER WATER MANAGEMENT SYSTEMS DIVISION

FIGURE 3

DEXTER/PEJ
1178-08-1

TABLE 2

DWMS SOIL VAPOR SURVEY
SUMMARY OF RESULTS

Sample	Total Benzene Equivalents (ppm)
VP-1	BDL
VP-2	BDL
VP-3	3.0
VP-4	10.1
VP-5	0.1
VP-6	0.2
VP-7	0.2
VP-8	0.3
VP-9	2.0
VP-10	BDL
VP-11	BDL
VP-12	2.0
VP-13	BDL
VP-14	NS
VP-15	NS
VP-16	31.8
VP-17	0.8
VP-18	0.6
VP-19	1.3
VP-20	1.3
VP-21	0.1
VP-22	0.1
VP-23	0.3
VP-24	1.9
VP-25	NS
VP-26	NS
VP-27	0.1
VP-27*	0.2

NOTES:
BDL – Below Detection Limits
NS – Location not sampled.
* – Sample collected at 6 feet below ground level.

Soil vapor analyses indicated total VOC concentrations as high as 27 ppm benzene equivalents which was detected at VP-16. The soil vapor survey indicated that small amounts volatile organic compounds are present around much of the facility perimeter. No VOC vapors were detected near the southeast corner of the site. These samples were collected in sandy fill material situated on the top of an embankment.

2.2 Ground Water Investigation

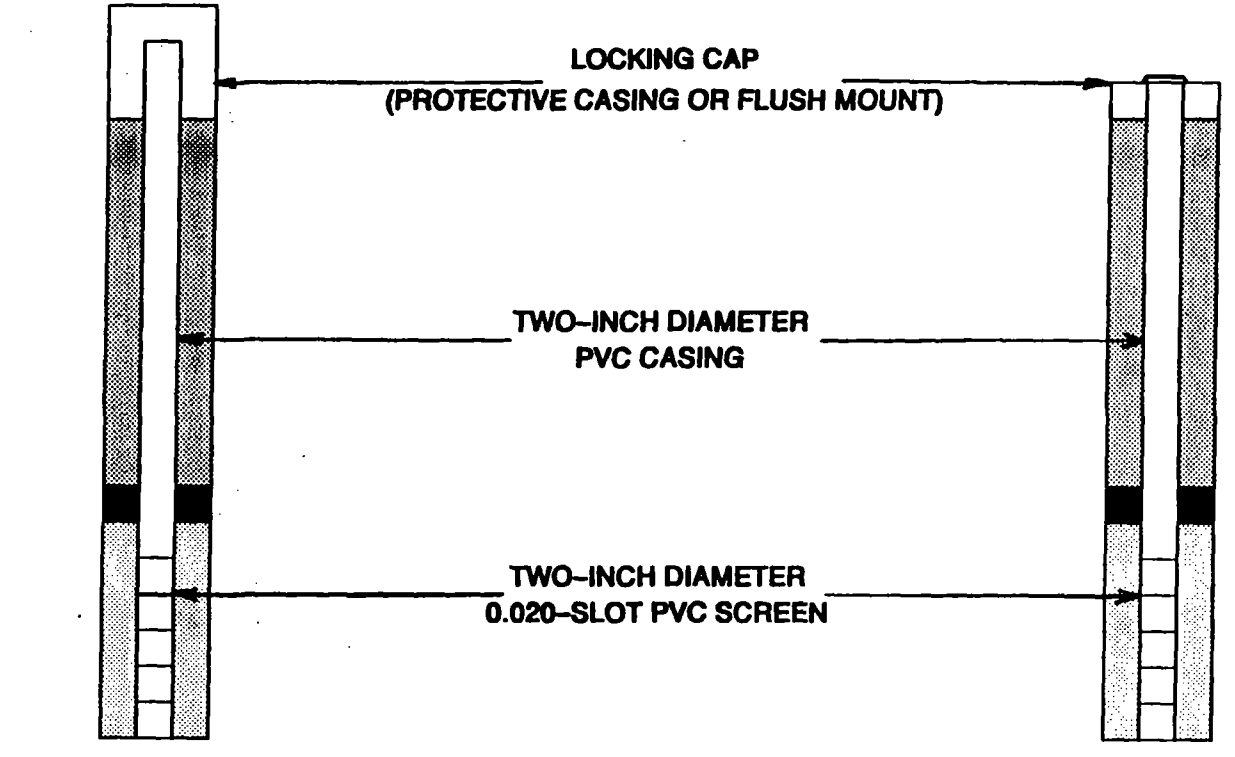
2.2.1 Monitoring Well Installation

Four ground water monitoring wells were installed at the site between April 5, 1991 and April 12, 1991. R & R International of Akron, Ohio was retained to install the monitoring wells. The borings were drilled with a truck mounted CME 75 drilling rig using a 4-1/4-inch diameter (I.D.) hollow stem auger. Soil samples were collected using a 2-foot long, 2-inch diameter split spoon sampler. All downhole drilling and sampling equipment was steam cleaned between each monitoring well installation. Cuttings from the test borings were placed in 55-gallon DOT approved lock ring steel drums and were stored on site for disposal by DWMS. Drilling logs are presented in Appendix A.

The split spoon samples were examined on-site by a Malcolm Pirnie geologist. The samples were described in terms of texture, color, and moistness. The upper portion of bedrock at the site is sufficiently weathered and fractured so that it could be drilled using hollow stem augers. Drilling and sampling continued down into the saturated bedrock until competent bedrock was reached and the augers could no longer be advanced.

The four bedrock monitoring wells are constructed of 2-inch diameter Schedule 40 polyvinyl chloride (PVC) casing and screen. A silica sand pack was placed in each well to approximately two feet above the top of the 0.020-slot screen. Bentonite pellets were then placed above the sand pack. The remainder of the annulus was filled with cement grout. Monitoring wells MW-1 and MW-2 were completed in flush mount curb boxes; MW-3 and MW-4 were completed with a protective casing and locking cap. Typical well construction details are shown on Figure 4.

The monitoring wells were developed by bailing with a four-foot long, one-inch diameter PVC bailer. Approximately 50 gallons of water and sediment were removed form each well. At the time well development was terminated, the formation water remained slightly cloudy. The formation was then allowed to stabilize until the planned ground water sampling was completed. Development water was placed in 55-gallon steel drums which



NOT TO SCALE

MALCOLM PIRNIE

MONITORING WELL CONSTRUCTION DETAILS
DEXTER WATER MANAGEMENT SYSTEMS DIVISION

FIGURE 4

FILE/pej
1178-08-1

were stored on site. The contents of the drums have been sampled and tested by DWMS and will be disposed by DWMS according to applicable regulations.

2.2.2 Ground Water Sampling and Water Level Measurements

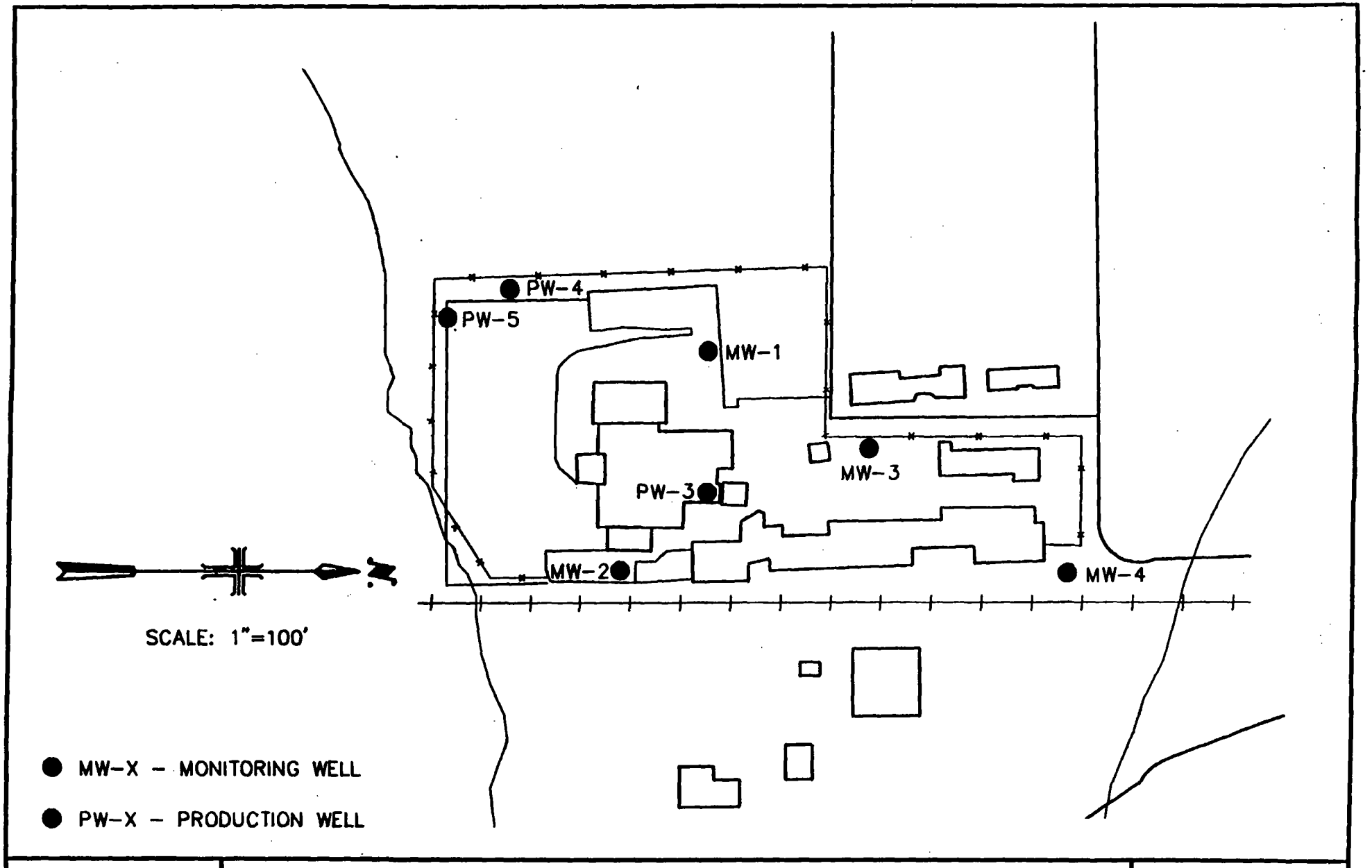
A ground survey was completed to measure the monitoring well top of casing elevations and ground elevations at each monitoring well location. Three of the DWMS production wells were also included in the survey. The top of casing elevations were measured to the nearest 0.01 feet; ground elevations were surveyed to the nearest 0.1 feet. The survey was required so that the drilling logs could be correlated accurately and also so that precise ground water elevations could be measured. The locations of the monitoring wells and DWMS production wells are shown on Figure 5.

Ground water levels were measured, using an electronic probe and tape. At the time the ground water samples were collected, on May 8, 1991, water level elevations in the four monitoring wells were measured. Water level elevations were measured in both the monitoring wells and three production wells on June 19, 1991. Both sets of measurements are presented on Table 3.

Ground water samples were collected from the four monitoring wells on May 8, 1991. Each well was purged by means of a cleaned one-inch diameter PVC bailer until at least three well volumes of ground water were removed even though the wells recovered slowly. The ground water was then sampled using the bailer. The bailer was cleaned between purging and sampling each monitoring well with a methanol wash and distilled water rinse. The ground water samples were filtered and preserved as appropriate, labeled, and placed in shipping containers along with ice packs. Chain of custody forms were completed for each container; copies of the forms are presented in Appendix B.

2.2.3 Analytical Methods

The ground water samples were analyzed for both Target Compound List (TCL) organic compounds and Target Analyte List (TAL) inorganic compounds. The organic analyses included Method 8240 for volatile organic compounds (VOCs), method 8270 for semi-volatile organic compounds and method 8080 for pesticides and polychlorinated biphenyls (P/PCBs). The inorganic analytes were analyzed using SW-846 methods with the exception of cyanide which was analyzed using method 335.2. The laboratory samples were analyzed and the data were reported under Level III CLP protocol. A review of the analytical results and the laboratory protocol used indicates that the analyses were within the EPA criteria for the indicated methods.

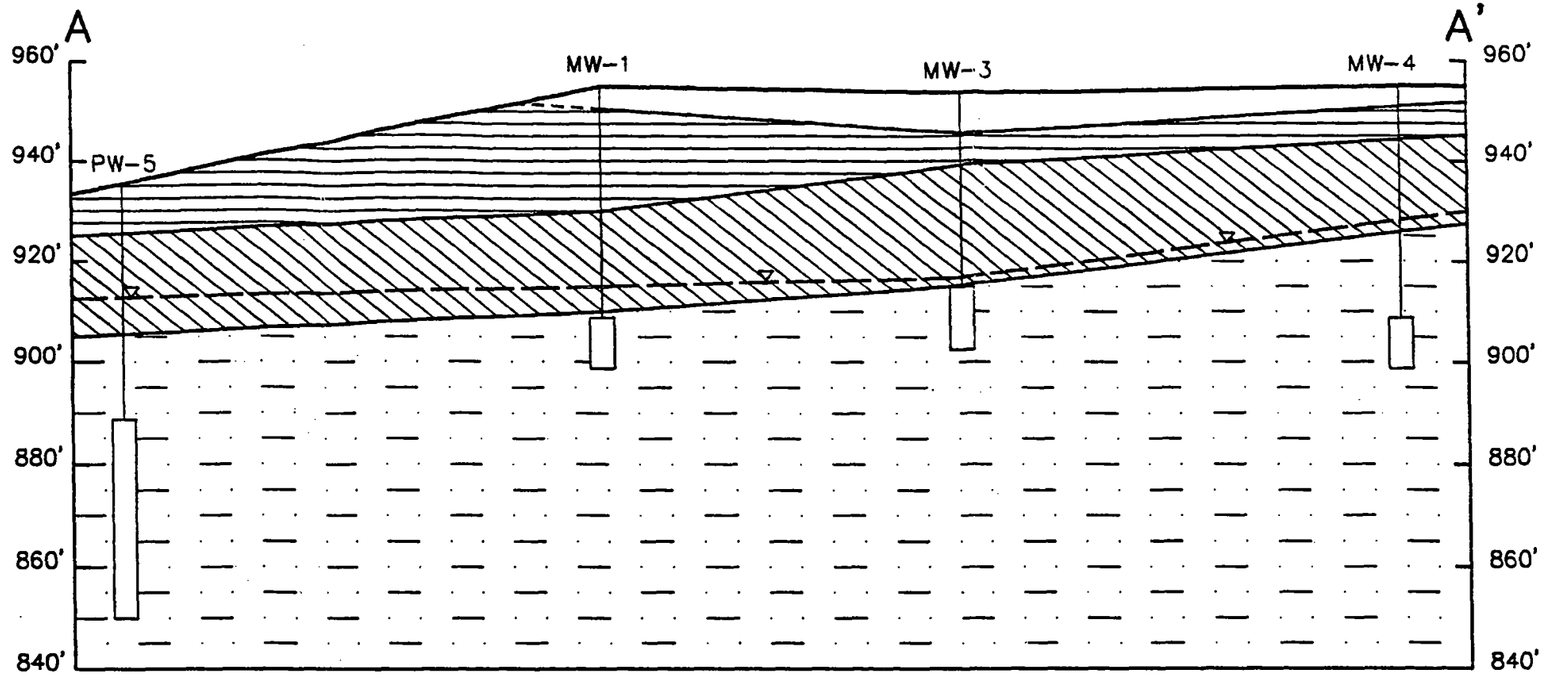


MALCOLM PIRNIE

MONITORING WELL LOCATIONS
DEXTER WATER MANAGEMENT SYSTEMS DIVISION

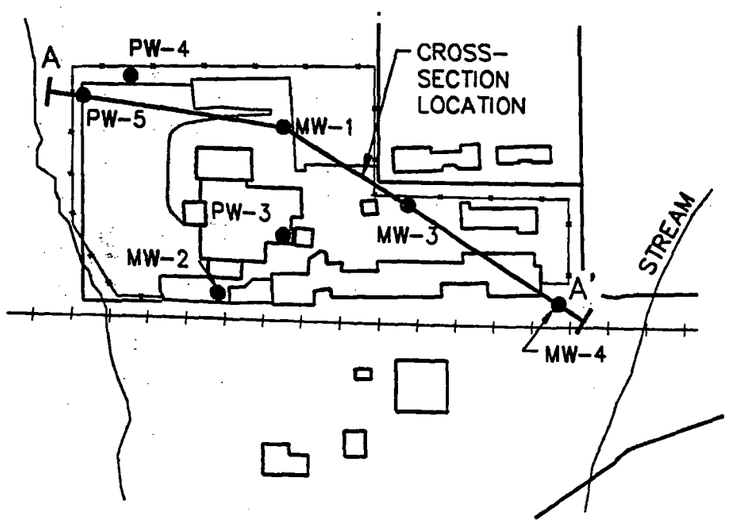
FIGURE 5

FILE/mre
XXXX-XX-X



PROFILE A–A'

VERTICAL SCALE: 1"=30'
HORIZONTAL SCALE: 1"=60'



BACKFILL MATERIAL

BROWN SILTY CLAY

GRAY TILL

INTERBEDDED SHALE, SILTSTONE & SANDSTONE

MALCOLM PIRNIE

GEOLOGIC CROSS SECTION

DEXTER WATER MANAGEMENT SYSTEMS DIVISION

FIGURE 6

TABLE 3

DWMS WATER LEVEL SURVEY
SUMMARY OF RESULTS

Well Number	Water Level Elevation May 8, 1991	Water Level Elevation June 19, 1991
MW-1	914.67	914.38
MW-2	930.47	930.24
MW-3	916.32	916.46
MW-4	928.62	928.85
PW-3	NM	916.95
PW-4	NM	904.39
PW-5	NM	908.60

NOTES:
Water Level Elevations in feet above mean sea level.
NM – Water level not measured.

3.0 SITE HYDROGEOLOGY

3.1 Regional Hydrogeology

3.1.1 Regional Aquifers

According to a study completed by the US Geological Survey (USGS) (Eberts, et al. 1990) this area is located in the Glaciated Allegheny Plateau physiographic province. The local topography is controlled by eroded bedrock hills covered with a thin veneer of glacial till and soil; the valleys consist of partially filled buried glacial valleys. The modern drainage system follows these buried valleys. Ground water supplies developed in the buried valleys and lowlands where the glacial deposits are thickest yield from several gallons per minute (GPM) to over 400 GPM. The yield is reported to be dependent on both the thickness and character of the formation and also the well construction.

The USGS report identifies the Paleozoic rocks which underlie the area as the Pennsylvanian Pottsville Formation and the Mississippian-age Cuyahoga Group and Berea Sandstone. The Pottsville Formation consists mostly of sandstone with local channels of conglomerate and has reported domestic yields of ground water ranging from 5 to 35 GPM. Based on the USGS report, the Pottsville is apparently not present in the vicinity of DWMS.

The Mississippian-age Cuyahoga group consists of up to 200 feet of interbedded shales, siltstones, and fine-grained sandstones. Even though the formations in this group consist mostly of fine-grained sediment, water moves along the fractures, joints and bedding planes within the unit. According to Scott Bair (Personal communication), the Pottsville Formation and Cuyahoga Group formations are highly fractured and computer modeling of the region, completed as part of the USGS study, indicated that ground water movement through the bedrock in Geauga County was fairly uniform. That is, on a regional scale, ground water flow and aquifer characteristics can be analyzed using standard Theis assumptions and equations.

The Berea Sandstone is a relatively well-sorted quartz sandstone and is one of the more productive bedrock aquifers in the region, especially where it is not too deeply buried and weathering has enlarged joints within the formation near the land surface. The USGS report indicates that the Berea is present along the Chagrin River in Chagrin Falls. Based on the report, the formation should be present below the DWMS facility within 100 feet of the ground surface. The DWMS production wells are probably completed in the Berea.

The Berea is underlain by more than 500 feet of low permeability Devonian and Mississippian age shales. These formations, according to the USGS, do not meet the demands of domestic (or industrial) use.

3.1.2 Aquifer Recharge

According to the USGS report, precipitation is the source of virtually all ground water within Geauga County. Recharge from precipitation to the underlying bedrock occurs indirectly as vertical leakage of ground water from overlying aquifers, except in areas where the bedrock is exposed in outcrop. In those areas or where the overlying glacial sediments are relatively thin, recharge is more direct. The USGS also notes that all of the stream reaches in Geauga county are gaining or effluent reaches. That is, both the unconsolidated sediments and bedrock formations discharge to the major streams and tributaries in the area, including the Chagrin River. Because of this relationship between regional recharge and discharge, ground water movement is generally vertically downward from the uplands to the stream valleys where it is discharged.

3.1.3 Ground Water Use

According to Eberle and McClure, 1984, 98 percent of the ground water used in Geauga County is for public and rural water supplies and for livestock use. Only 2 percent was for manufacturing.

3.2 Local Hydrogeology

The geologic cross section presented in Figure 6 summarizes the shallow site stratigraphy as observed during installation of the monitoring wells and from well logs and test boring logs provided by DWMS. The soil units at the site consist of an upper zone of sand, silt, clay. In areas where no fill was present the zone is characterized by interbedded layers of sand, silt, and clay of varying thicknesses. This zone is about 10 to 20 feet thick across the site and is characterized by its brown to reddish brown color. Portions of this material, especially the sand seams and the fill areas were saturated and released small amounts of water into the borehole.

Below this zone is a layer of gray glacial till. The till consists of poorly sorted clay and silt with a trace of sand; there were no bedding planes evident in split spoon samples collected in the till zone. Moisture in the till varied from a trace to areas that were saturated. The till varied from approximately 10 to 25 feet in thickness across the site. Based on the high clay content of the till, this zone provides a significant barrier to the downward migration of ground water at the DWMS facility.

Bedrock at the facility consists of interbedded shale, siltstone and fine-grained sandstone, probably of the Cuyahoga group. The upper bedrock zone was saturated and

highly weathered. Competent material was encountered 10 to 15 feet into the bedrock; drilling was not continued in any of the borings past the point of auger refusal.

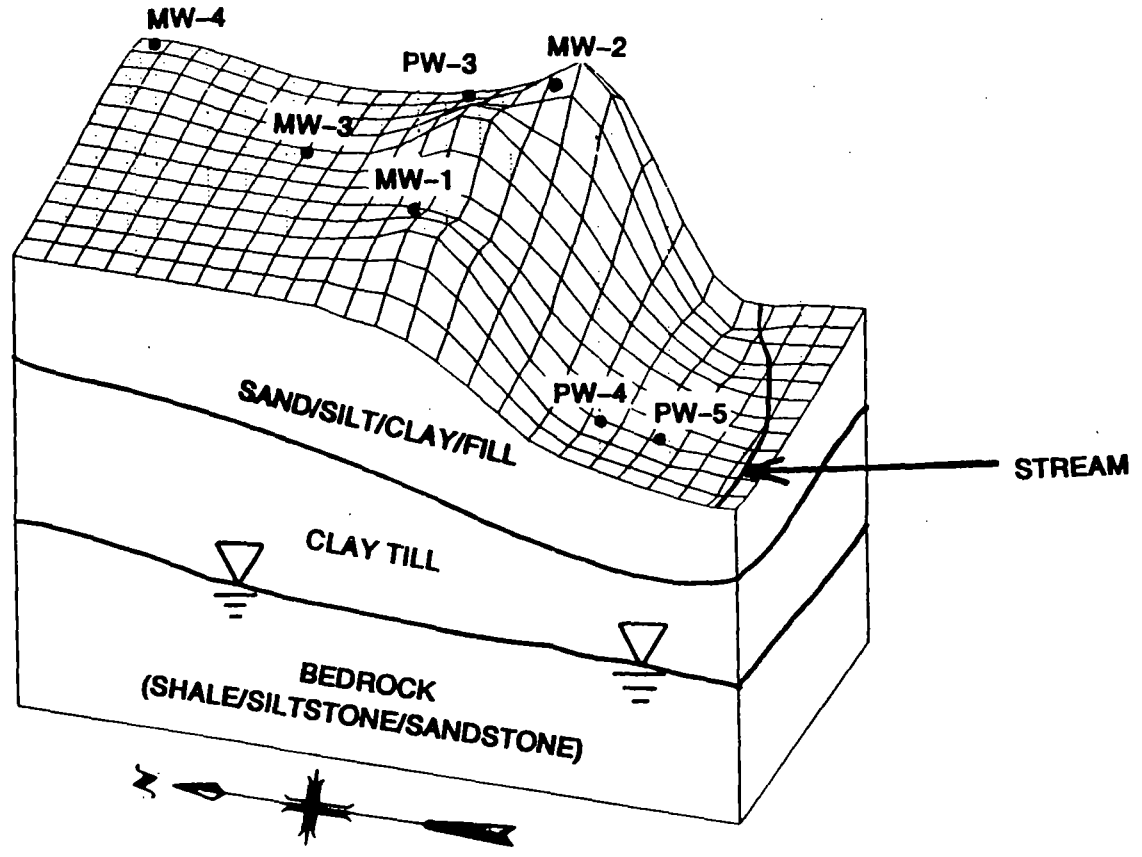
The block diagram on Figure 7 shows the relative relationship of the water table to the three identified stratigraphic units. As shown on the block diagram the water table is approximately coincident with the top of the weathered bedrock surface. Based on the two sets of water level measurements the hydraulic gradient across the site dips towards the Chagrin River from east to west at a rate of approximately 0.10 ft/ft. This gradient is very steep and appears to be controlled by the bedrock topography. The facility is less than one-half mile from the Chagrin River.

3.3 Ground Water Quality

Although low concentrations of organic contaminants were detected in the nearby residential wells and in the DWMS production wells during previous sampling events, there were no organic compounds present at or above method detection limits in the monitoring well samples collected May 8, 1991. A summary of the analytical results for the monitoring wells is presented on Tables 4 through 7; a review of the data quality and the raw analytical data is presented in Appendix B.

Several inorganic compounds were detected in the ground water samples collected from the monitoring wells. Barium was detected in all of the samples but at concentrations within normal limits for waters from the Cuyahoga Group (Eberts, et al., 1990) and at concentrations below the US EPA Maximum Contaminant Level (MCL). Trace levels of mercury were also present in the samples but at concentration below the MCL of 0.002 mg/l. Other inorganic compounds detected include calcium, iron, magnesium, manganese, sodium, and vanadium. Iron was present at concentrations above secondary MCLs but at concentrations typical of ground water from the Cuyahoga Group (Eberts, et al., 1990). There are no water quality standards established for the other detected parameters.

Based on information provided by Dexter and other information from the Chagrin Falls Water Department, several of the municipal supply wells for Chagrin Falls are no longer used due to high iron and sulfate in the water. Although drilling logs for the wells could not be located, it is likely that these wells, which are located in Bainbridge Township, were completed in the Berea sandstone.



DRAWING NOT TO SCALE

MALCOLM PIRNIE

BLOCK DIAGRAM
DEXTER WATER MANAGEMENT SYSTEMS DIVISION

FIGURE 7

FILE/mre
XXXX-XX-X

TABLE 4

DWMS GROUND WATER MONITORING RESULTS
VOLATILE ORGANIC ANALYSES

COMPOUND	MONITORING WELL RESULTS (µg/L)			
	MW-1	MW-2	MW-3	MW-4
Chloromethane	<10	<10	<10	<10
Bromomethane	<10	<10	<10	<10
Vinyl chloride	<10	<10	<10	<10
Chloroethane	<10	<10	<10	<10
Methylene chloride	<5.0	<5.0	<5.0	<5.0
Acetone	<10	<10	<10	<10
Carbon disulfide	<5.0	<5.0	<5.0	<5.0
1,1-Dichloroethene	<5.0	<5.0	<5.0	<5.0
1,1-Dichloroethane	<5.0	<5.0	<5.0	<5.0
1,2-Dichloroethene (total)	<5.0	<5.0	<5.0	<5.0
Chloroform	<5.0	<5.0	<5.0	<5.0
1,2-Dichloroethane	<5.0	<5.0	<5.0	<5.0
2-Butanone	<10	<10	<10	<10
1,1,1-Trichloroethane	<5.0	<5.0	<5.0	<5.0
Carbon tetrachloride	<5.0	<5.0	<5.0	<5.0
Vinyl acetate	<10	<10	<10	<10
Bromodichloromethane	<5.0	<5.0	<5.0	<5.0
1,2-Dichloropropane	<5.0	<5.0	<5.0	<5.0
c-1,3-Dichloropropene	<5.0	<5.0	<5.0	<5.0
Trichloroethene	<5.0	<5.0	<5.0	<5.0
Dibromochloromethane	<5.0	<5.0	<5.0	<5.0
1,1,2-Trichloroethane	<5.0	<5.0	<5.0	<5.0
Benzene	<5.0	<5.0	<5.0	<5.0
t-1,3-Dichloropropene	<5.0	<5.0	<5.0	<5.0
Bromoform	<5.0	<5.0	<5.0	<5.0
4-Methyl-2-pentanone	<10	<10	<10	<10
2-Hexanone	<10	<10	<10	<10
Tetrachloroethene	<5.0	<5.0	<5.0	<5.0
Toluene	<5.0	<5.0	<5.0	<5.0
1,1,2,2-Tetrachloroethane	<5.0	<5.0	<5.0	<5.0
Chlorobenzene	<5.0	<5.0	<5.0	<5.0
Ethylbenzene	<5.0	<5.0	<5.0	<5.0
Styrene	<5.0	<5.0	<5.0	<5.0
Xylene (total)	<5.0	<5.0	<5.0	<5.0

NOTE: Sampling date 05/08/91

TABLE 5

DWMS GROUND WATER MONITORING RESULTS
SEMI-VOLATILE ORGANIC ANALYSES

COMPOUND	MONITORING WELL RESULTS (μg/L)			
	MW-1	MW-2	MW-3	MW-4
Phenol	<10	<10	<10	<10
bis(2-Chloroethyl)ether	<10	<10	<10	<10
2-Chlorophenol	<10	<10	<10	<10
1,3-Dichlorobenzene	<10	<10	<10	<10
1,4-Dichlorobenzene	<10	<10	<10	<10
Benzylalcohol	<10	<10	<10	<10
1,2-Dichlorobenzene	<10	<10	<10	<10
2-Methylphenol	<10	<10	<10	<10
bis(2-Chloroisopropyl)ether	<10	<10	<10	<10
4-Methylphenol	<10	<10	<10	<10
n-Nitrosodi-n-propylamine	<10	<10	<10	<10
Hexachloroethane	<10	<10	<10	<10
Nitrobenzene	<10	<10	<10	<10
Isophorone	<10	<10	<10	<10
2-Nitrophenol	<10	<10	<10	<10
2,4-Dimethylphenol	<10	<10	<10	<10
Benzoic acid	<50	<50	<50	<50
bis(2-Chloroethoxy)methane	<10	<10	<10	<10
2,4-Dichlorophenol	<10	<10	<10	<10
1,2,4-Trichlorobenzene	<10	<10	<10	<10
Napthalene	<10	<10	<10	<10
4-Chloroaniline	<10	<10	<10	<10
Hexachlorobutadiene	<10	<10	<10	<10
4-Chloro-3-methylphenol	<10	<10	<10	<10
2-Methylnaphthalene	<10	<10	<10	<10
Hexachlorocyclopentadiene	<10	<10	<10	<10
2,4,6-Trichlorophenol	<10	<10	<10	<10
2,4,5-Trichlorophenol	<50	<50	<50	<50
2-Chloronaphthalene	<10	<10	<10	<10
2-Nitroaniline	<50	<50	<50	<50
Dimethylphthalate	<10	<10	<10	<10
Acenapthylene	<10	<10	<10	<10
2,6-Dinitrotoluene	<10	<10	<10	<10
3-Nitroaniline	<50	<50	<50	<50

TABLE 5 (continued)

DWMS GROUND WATER MONITORING RESULTS
SEMI-VOLATILE ORGANIC ANALYSES

COMPOUND	MONITORING WELL RESULTS (μg/L)			
	MW-1	MW-2	MW-3	MW-4
Acenaphthene	<10	<10	<10	<10
2,4-Dinitrophenol	<50	<50	<50	<50
4-Nitrophenol	<50	<50	<50	<50
Dibenzofuran	<10	<10	<10	<10
2,4-Dinitrotoluene	<10	<10	<10	<10
Diethylphthalate	<10	<10	<10	<10
4-Chlorophenyl-phenylether	<10	<10	<10	<10
Fluorene	<10	<10	<10	<10
4-Nitroaniline	<50	<50	<50	<50
4,6-Dinitro-2-methylphenol	<50	<50	<50	<50
n-Nitrosodiphenylamine	<10	<10	<10	<10
4-Bromophenyl-phenylether	<10	<10	<10	<10
Hexachlorobenzene	<10	<10	<10	<10
Pentachlorophenol	<50	<50	<50	<50
Phenanthrene	<10	<10	<10	<10
Anthracene	<10	<10	<10	<10
Di-n-butylphthalate	<10	<10	<10	<10
Fluoranthene	<10	<10	<10	<10
Pyrene	<10	<10	<10	<10
Butylbenzylphthalate	<10	<10	<10	<10
3,3-Dichlorobenzidine	<20	<20	<20	<20
Benzo(a)anthracene	<10	<10	<10	<10
Chrysene	<10	<10	<10	<10
bis(2-Ethylhexyl)phthalate	<10	<10	<10	<10
Di-n-octylphthalate	<10	<10	<10	<10
Benzo(b)fluoranthene	<10	<10	<10	<10
Benzo(k)fluoranthene	<10	<10	<10	<10
Benzo(a)pyrene	<10	<10	<10	<10
Indeno(1,2,3-cd)pyrene	<10	<10	<10	<10
Dibenzo(a,h)anthracene	<10	<10	<10	<10
Benzo(ghi)perylene	<10	<10	<10	<10

NOTE: Sampling date 05/08/91

TABLE 6

DWMS GROUND WATER MONITORING RESULTS
PESTICIDE/PCB ANALYSES

COMPOUND	MONITORING WELL RESULTS (µg/L)			
	MW-1	MW-2	MW-3	MW-4
BHC,alpha	<0.05	<0.05	<0.05	<0.05
BHC,beta	<0.05	<0.05	<0.05	<0.05
BHC,delta	<0.05	<0.05	<0.05	<0.05
BHC,gamma (Lindane)	<0.05	<0.05	<0.05	<0.05
Heptachlor	<0.05	<0.05	<0.05	<0.05
Aldrin	<0.05	<0.05	<0.05	<0.05
Heptachlor epoxide	<0.05	<0.05	<0.05	<0.05
Endosulfan I	<0.05	<0.05	<0.05	<0.05
Dieldrin	<0.10	<0.10	<0.10	<0.10
4,4'DDE	<0.10	<0.10	<0.10	<0.10
Endrin	<0.10	<0.10	<0.10	<0.10
Endosulfan II	<0.10	<0.10	<0.10	<0.10
4,4'DDD	<0.10	<0.10	<0.10	<0.10
Endosulfan sulfate	<0.10	<0.10	<0.10	<0.10
4,4'DDT	<0.10	<0.10	<0.10	<0.10
Methoxychlor	<0.50	<0.50	<0.50	<0.50
Endrin ketone	<0.10	<0.10	<0.10	<0.10
Chlordane, alpha	<0.50	<0.50	<0.50	<0.50
Chlordane, gamma	<0.50	<0.50	<0.50	<0.50
Toxaphene	<1.00	<1.00	<1.00	<1.00
Aroclor-1016	<0.50	<0.50	<0.50	<0.50
Aroclor-1221	<0.50	<0.50	<0.50	<0.50
Aroclor-1232	<0.50	<0.50	<0.50	<0.50
Aroclor-1242	<0.50	<0.50	<0.50	<0.50
Aroclor-1248	<0.50	<0.50	<0.50	<0.50
Aroclor-1254	<1.00	<1.00	<1.00	<1.00
Aroclor-1260	<1.00	<1.00	<1.00	<1.00

NOTE: Sampling date 05/08/91

TABLE 7

DWMS GROUND WATER MONITORING RESULTS
METALS/CYANIDE ANALYSES

ANALYTE	MONITORING WELL RESULTS (µg/L)			
	MW-1	MW-2	MW-3	MW-4
Aluminum	<0.1	<0.1	<0.1	<0.1
Antimony	<0.2	<0.2	<0.2	<0.2
Arsenic	<0.004	<0.004	<0.004	<0.004
Barium	0.09	0.03	0.08	0.03
Beryllium	<0.01	<0.01	<0.01	<0.01
Cadmium	<0.01	<0.01	<0.01	<0.01
Calcium	28	25	23	26
Chromium	<0.02	<0.02	<0.02	<0.02
Cobalt	<0.02	<0.02	<0.02	<0.02
Copper	<0.02	<0.02	<0.02	<0.02
Iron	1.1	0.04	1.6	1.2
Lead	<0.005	<0.005	<0.005	<0.005
Magnesium	7.9	8.5	6.4	8.4
Manganese	0.30	0.17	0.38	0.15
Mercury	0.0005	0.0002	<0.0002	<0.0002
Nickel	<0.04	<0.04	<0.04	<0.04
Potassium	<	<	<	<
Selenium	<0.004	<0.004	<0.004	<0.004
Silver	<0.04	<0.04	<0.04	<0.04
Sodium	3.8	7.9	12	7.9
Thallium	<0.005	<0.005	<0.005	<0.005
Vanadium	0.06	0.06	0.04	0.05
Zinc	<0.01	<0.01	<0.01	<0.01
Cyanide	<0.01	<0.01	<0.01	<0.01

NOTE: Sampling date 05/08/91

4.0 RESULTS AND CONCLUSIONS

4.1 Sources of Contamination

4.1.1 On-site Sources

Based on the presence of the low permeability glacial till layer and the fact that contaminants were not detected in the shallow bedrock monitoring wells, there does not appear to be any connection between the DWMS facility and the organic ground water contamination detected in nearby residential wells and the on-site production wells. Dichloroethane (DCA) is the organic compound which had been detected in the potable wells at concentrations exceeding the MCL of 5 ug/l. According to DWMS, this compound is not used presently nor was it used in the past for any of the production and maintenance operations at the facility.

4.1.2 Off-Site Sources

Other potential sources of contamination in the area are known to exist. A summary of relevant records of state and federal agencies was obtained from Environmental Audit, Inc. (EAI), a national database service. The database summary is presented in Appendix C. The database search was for zip code area 44022, which includes Chagrin Falls and the surrounding area. The following databases were included in the EAI data base search:

US EPA Database:

- National Priorities List (NPL)
- Facilities Index System (FINDS)
- Comprehensive Environmental Response, Compensation, and Liability Index System (CERCLIS)
- Resource Conservation and Recovery Act (RCRA) Notifiers List
- Solid Waste Facilities Not in Compliance with RCRA Subtitle D Criteria (OPEN DUMP)
- Emergency Response Notification System (ERNS)

State Database:

- State Priority List
- Solid Waste Facility Information

Enforcement Information

- Consolidated Docket Database Information
- RCRA Major Violators

Results of the data base search indicate the existence of numerous facilities in the area which use or produce hazardous materials. The EAI database search of federal facilities identified: 0 NPL sites; 45 FINDS sites; 4 CERCLIS sites; 39 RCRA facilities; 0 OPEN DUMP sites; and 0 ERNS sites. The state databases identified 5 facilities on the State Priorities List and 0 solid waste facilities. No sites were identified under the enforcements databases.

Although the individual facilities identified in the database search were not contacted for this investigation, the search indicates that other potential sources are located in the area. Some of these facilities may be located in hydrogeologic settings where site activities could have an impact on ground water quality. In addition to the identified sites there are numerous other sources in the area including gasoline stations, automobile and truck repair garages, dry cleaning businesses, and a US military maintenance facility.

Chem Masters Corporation, located at 477 Industrial Parkway, is situated hydraulically upgradient of DWMS. This facility has been identified in the state data base as a site or source of known environmental problems.

4.2 Conclusions

There is no evidence collected during this investigation which indicates that DWMS is a source of the ground water contamination identified in samples collected from the nearby residential and the DWMS production wells. The OEPA has notified DWMS that other potable wells in the area have been affected by organic contaminants including DCA. Because of the abundance of potential off-site sources and documentation of several known off-site releases, it is likely that regional ground water quality has been adversely affected by sources other than DWMS.